DOCUMENT RESUME

ED 224 450 HE 015 820

AUTHOR	Wong, Herbert Y.; Sanders, Jimy M.
TITLE	Gender Differences in the Attainment of Doctorates. Revised.
SPONS AGENCY	California Univ., Santa Barbara.
PUB DATE	Jan 82
GRANT	UC-8-448790-09499-3
NOTE	38p.; Paper to appear in "Sociological Perspectives."
PUB TYPE	Reports - Research/Technical (143) -- Statistical Data (110) -- Information Analyses (070)
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	Academic Achievement; Awards; *Doctoral Programs; Employment Potential; Equal Opportunities (Jobs); Faculty Advisers; Females; *Graduate Study; Higher Education; *Human Capital; Longitudinal Studies; *Professional Recognition; *Research Opportunities; *Sex Differences; Sex Discrimination; State Universities
IDENTIFIERS	*University of California Santa Barbara

ABSTRACT

Different and competing theories of the disadvantagement of women in academia are explored through reviews of the literature and an examination of the graduate training experiences of men and women. An explanatory model of graduate training experiences from a human capital theory approach is constructed that considers the human capital accumulated by individuals before and during graduate school. Performance after graduate school is then understood as a function of the total human capital accumulated. Data in the study were for all doctoral recipients of the University of California, Santa Barbara, from September 1972 through June 1978. Student variables controlled for include marital status, age, number of dependents, undergraduate experience, previous graduate study, graduate performance, awards and opportunities, and prestige of faculty advisor. Despite roughly equal beginning qualifications, women tended to accumulate less human capital than men during graduate school, and may not have had equal access to career-relevant opportunities and resources. Further encouragement of women's achievement is recommended, including constantly reminding women graduate students of the importance of research and assertiveness in research involvement, and active recruitment of women as research assistants. (MSE)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED224450

HE 015 820

GENDER DIFFERENCES IN THE ATTAINMENT OF DOCTORATES*

Herbert Y. Wong
Fielding Institute
Santa Barbara

Jimy M. Sanders
University of California
Santa Barbara

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Herbert Y. Wong

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

HE015820

*Funding for this study has been provided, in part, by the University of California (grant number 8-448790-09499-3). The project is being conducted through the facilities of the Social Process Research Institute at the University of California, Santa Barbara. We would like to thank Richard Berk, William Bielby and two anonymous reviewers for their comments on an earlier version of this paper.

Paper to appear in Sociological Perspectives (formally, Pacific Sociological Review)

ABSTRACT

The study of gender inequality in academia is characterized by various conflicting positions (e.g., Cole, 1979; Reskin, 1980). While it is clear such inequality exists, our knowledge of how it comes about is limited. Debate over the extent and interpretation of gender inequality in the academic labor market is exacerbated by this situation. The preliminary analysis reported here suggests that the inequality stems, in part, from different graduate training experiences encountered by female and male students.

BEST COPY

GENDER DIFFERENCES IN THE ATTAINMENT OF DOCTORATES

The argument is often made that affirmative action programs have been instrumental in helping to increase the number of women receiving advanced degrees. Eiden (1976) documented that between 1966 and 1976 the percentage of all degrees awarded to women at least doubled. The largest gains occurred at the higher degree levels. By 1977, one-fourth of all doctoral recipients were female (HEW, 1978). While these trends may be viewed as a major accomplishment for proponents of equal educational opportunity, such figures fail to demonstrate whether women have been fully integrated into the mainstream of graduate programs and how the professional credentials they accumulate compare with those of male students.

A useful perspective from which to examine these questions is provided by human capital theory (e.g., Mincer and Polacheck, 1974; Weisbrod, 1975; Wykstra, 1971). This perspective asserts that different types and quantities of human capital accumulation are expected to lead to differential productivity. Thus, individuals are not perfectly substitutable for one another in the market. Through the attainment of human capital, people are able to improve their expected marginal productivity relative to others. In the case of graduate students, human capital accumulation includes such things as acquiring research skills and publishing. Hence, potential for success in the academic labor market may be viewed, in part, as a function of accumulated human capital.

BEST COPY AVAILABLE

Women's disadvantaged position in academia is well documented. Several investigators (Bayer and Astin, 1968 and 1975; Centra, 1974; Cole, 1979; Epstein, 1973; Fulton, 1975; Marwell et al, 1979; and Zuckerman and Cole, 1975) have argued that these disadvantages appear to be partially dependent upon women being overly subject to geographical constraints due to their disproportionate representation in two career families. Child rearing, other family responsibilities and emphasizing teaching over research have also been suggested as important factors (Folger et al., 1970). However, these characteristics do not appear to account fully for the extensiveness of differential gender attainment in academia (Astin and Bayer, 1973; Crandall, 1975; Nielsen, 1979; Fox, 1981). Unfortunately, previous research has not adequately taken into account aspects of graduate school experience that may contribute to gender inequality in academia. Further, most prior research has not examined the professional productivity of students at the time they received their degrees. These matters should be considered given their potential impact on careers.

Employing the arguments of Alexis (1974), Krueger (1963), Phelps (1972), and Thurow (1979), men in academia may have undue advantages (i.e., statistical discrimination) over women in obtaining important resources necessary for maximizing human capital accumulation during graduate school. Alternatively, women may tend to be unsuccessful in transforming equal resources into equal return. To evaluate these competing hypotheses and to improve our understanding of

BEST COPY AVAILABLE

the sources of labor market problems faced by women in academia requires closer examination of the graduate training experiences of women and men.

The available evidence suggests that women and men have been admitted into graduate programs in the same proportion as they apply for some time (Zuckerman and Cole, 1975). However, since traditionally fewer women applied for graduate study, they have represented a minority of all graduate students. In terms of pre-graduate school qualifications, the high school and undergraduate academic records of female graduate students have usually been superior to those of male graduate students (Hirschberg and Itkin, 1978; Roby, 1973).

Early studies found little evidence of differential financial support for men and women. Astin (1969) found no difference in the proportion of fellowships or graduate assistantships awarded to women and men. However, she was unable to differentiate "assistantships" into TA's, RA's or other forms of support. Bernard (1964) reported that NSF awards in 1959 were obtained by women in the same ratio as men. Centra (1974) concluded that men and women attained similar numbers of graduate fellowships but men were somewhat more likely to receive teaching assistantships.

However, female graduate students were found to have particular difficulty in establishing themselves in relationships of master and apprentice. During a 1969 ACE-Carnegie Commission survey of graduate students from 153 institutions, 21 percent of the men and 31 percent of the women thought that professors in their own departments did not

BEST COPY AVAILABLE

deal as seriously with female as with male graduate students (Creager, 1971). Holmstrom and Holmstrom (1974) reported that after controlling for academic ability, financial worries, and family demands, female graduate students had more negative experiences with their faculty members than male graduate students. Also, female graduate students have expressed a general belief that sex discrimination in graduate school discourages women from completing their degrees (Centra, 1974). These perceptions appear to be accurate assessments of the experiences encountered by many graduate women (Feldman, 1973; Harris, 1974).

More recent research has shown that faculty sponsorship as well as teaching and research training are important determinants of initial placement and career development (Long, 1978; Long and McGinnis, 1981; Long et al., 1979; McGinnis et al., 1982). One implication of these studies, in conjunction with those previously cited, is that it is plausible that the employment experiences of women doctorates reflect earlier difficulties in establishing working relationships with prestigious professors and gaining access to various departmental resources and opportunities.

A comparative examination of how men and women move through graduate programs should provide an improved understanding of how the gender stratified scholastic career market might be perpetuated. In particular, accessibility to productive faculty members, the awarding of TA's, RA's and fellowships, and scholarly productivity at the time of graduation represent among the most important dimensions of

BEST COPY AVAILABLE

graduate training. While the exemplary research of Long and his associates finds little relationship between publications at graduation and job placement, an important limitation of these studies should be considered. The data examined are of male biochemists who graduated in the late 1950's and early 1960's. In recent years, opportunity in the academic labor market has become increasingly austere. Although we are unaware of contemporary empirical documentation of the growing salience of publications for initial job placement, the phenomenon clearly exists.

As Reskin (1977) has pointed out, probably the most serious problem for women in academia is their relative lack of practical resources and opportunities conducive to research activity. The literature reviewed suggests that such difficulties are partially rooted in the professional training received by graduate students. In the remainder of this paper we examine several relationships that hypothetically may differentiate the human capital accumulation of men and women in graduate school. In closing, we discuss what these relationships imply about equality of opportunity in graduate training.

THE MODEL

From a human capital approach, an explanatory model of graduate training experiences should consider the human capital accumulated by individuals before entering graduate school (e.g.,undergraduate grades) and that accumulated during graduate school (e.g., research experience). Performance at the conclusion of graduate training may be understood as a

BEST COPY AVAILABLE

function of the total human capital accumulation of students.

(Place Figure 1 about here.)

As depicted in Figure 1, the scholarly prestige of faculty advising and sponsorship attained by students, the departmental rewards received and scholarly production at the end of graduate training were predicted to be directly associated with four sets of variables that characterize graduate students. These characteristics reflect human capital resources that influence students' likelihood of gaining additional forms of human capital (e.g., research assistantships) available in graduate school. Scholarly production was also predicted to be directly affected by mentor scholarly prestige and departmental awards accumulated by students during their graduate studies.[1]

The general discipline of study was controlled because the availability of human capital represented by the endogenous variables differed by groups of departments. For example, more research opportunities were available to students in the natural sciences than to students in the arts.

Demographic characteristics of students were modeled to control for potential effects that family responsibilities or statistical discrimination (Phelps, 1972) may have on human capital accumulation in graduate school. For example, faculty perceptions of student liabilities (e.g., too young, too old, having to spend time caring for children) represent evaluations of human capital. Statistical discrimination is not required for these factors to affect graduate student progress however. For example, being married may tend to help

BEST COPY AVAILABLE

(or hurt) student progress because of various personal reasons net of any form of discrimination.

Previous academic credentials were also predicted to influence the human capital accumulation of students during their graduate studies. These variables serve as indicators of the potential for success each student brings to graduate school. Furthermore, departmental awards and opportunities are, in part, used to recruit attractive students and later to reward progressing students. Simultaneously, faculty members are likely to be more interested in allocating their time and other resources to better rather than poorer students. Similarly, academic performance during graduate school was expected to affect students' scholarly production as well as their likelihood of attaining departmental awards and working with prestigious professors.[2]

DATA

The data pertain to virtually all U.S. citizens who received a Ph.D. at the University of California, Santa Barbara between September 1972 and June 1978.[3] A total of 112 female and 599 male graduates were considered. All data were gathered from university records unless otherwise noted.

Discipline of study was operationalized with 2 dummy variables. These distinguished the natural sciences (i.e., biology, botany, chemistry, engineering, geology, geography, mathematics, and physics), the arts (i.e., art, drama, English, French, German, Spanish and music), and the social sciences (i.e., anthropology, economics, education, history, philosophy, political science, psychology, religious studies

BEST COPY AVAILABLE

and sociology). The social sciences were used as a reference group.

Student demographic variables controlled for included marital status (binary: 1 = married and living together), age, and number of dependents. These variables reflect student characteristics at the beginning of their graduate studies.

Four aspects of previous academic credentials were considered. These were undergraduate GPA, the number of fellowships awarded as an undergraduate, the quality of students' undergraduate institution (in terms of the average SAT score of students at that school as reported by Astin, 1971), and whether students had participated in graduate study prior to entering the program from which they attained their Ph.D. (binary: 1 = yes).

Academic performance in graduate school was controlled by considering graduate GPA and the number of years required by students to complete their degrees. These variables provide an index of both the quality and pace of student progress through graduate school.

Departmental awards and opportunities were measured in terms of 3 variables. These were the number of years of support obtained by students through TA's, RA's and fellowships.

The scholarly prestige of the faculty advisor was measured in terms of both the number of extramural grants and the number of citations in professional journals (ISI, 1970-80) received by the dissertation chairperson during the four year period just prior to each student's graduation.[4]

BEST COPY AVAILABLE

Scholarly production at the conclusion of graduate school was measured as the number of professional papers accepted for publication at the time of graduation.[5] Publications were emphasized because they indicate recognition in the discipline and because of their growing importance in the labor market.

FINDINGS

In order to facilitate a thorough comparison of the graduate school experiences of women and men, separate analyses were conducted. Table 1 provides a descriptive comparison of the two groups. Additional descriptive information is provided in appendix form. Table 2 provides a contrast of gender differences in human capital accumulation during graduate school by discipline in order to control for the differential availability of resources across areas of study.

(Place Tables 1 and 2 about here.)

From Table 2, we see that women received fewer RA's in the arts and the natural sciences than men. The reverse pattern existed in the social sciences. Given that RA's were relatively unusual in the arts, the largest difference was that between the social and natural sciences. The awarding of TA's among women and men was similar across disciplines, with male students having a small advantage. Females tended to obtain more fellowships than males, especially in the natural sciences. Mentor grant receipt and citation record were slightly favorable for men in the arts and natural sciences. On the contrary, women in the social sciences tended to work with somewhat better cited mentors than did men. Finally,

BEST COPY AVAILABLE

women tended to publish less than men across all disciplines. The smallest of these differences existed in the social sciences.

Considering Tables 1 and 2, we see that few human capital differences between women and men were present at the onset of graduate study. By graduation however, within discipline differences in the attainment of departmental rewards and opportunities and scholarly production sometimes reflected large differences between the sexes. The following analyses will attempt to disentangle the processes through which these differences have been generated.[6] The discussion will generally be limited to relationships having substantively meaningful metric interpretations.

(Place Tables 3a and 3b about here.)

With equation 1 (Tables 3a and 3b), we examined the net relationships involving RA assignment. Among women, number of dependents was positively related to RA support. Also, women in the arts averaged one-half year less RA support than other women. For men, undergraduate GPA was negatively related to RA support. The strongest relationship was that men in the natural sciences averaged nine-tenths of a year more RA support than other men.

These findings suggest that male graduate students enjoyed a nontrivial advantage in obtaining RA's over their female counterparts in both the natural sciences and arts relative to students in the social sciences. If our model is reasonably accurate, unless men in both the arts and natural sciences (but not in the social sciences) were somehow more

BEST COPY AVAILABLE

motivated in seeking research positions or they were in some other presumably meritocratic way more attractive to professors as RA's than were women, these results indicate that women and men were treated differently between areas of study regarding the awarding of research positions.[7]

In equation 2, we considered the determinating influences of TA assignment. Among women, the probability of being married and pace of graduate study had positive effects on TA support. For men, TA support appears to have been substantively increased by studying in the arts or the natural sciences relative to the social sciences. Prior graduate training also had a meaningful, although smaller, positive net relationship with TA support.

Again, potentially important differences between the graduate experiences of men and women were indicated. For example, men in the natural sciences and the arts tended to experience a net gain in TA support relative to men in the social sciences. It is not clear that women in the natural sciences and arts received similar relative advantages. Although female and male graduate students obtained roughly equal TA support overall, the processes by which these awards were obtained appear to have differed by gender.

The awarding of graduate fellowships was considered in equation 3. For women, undergraduate fellowship awards, studying in the natural sciences and undergraduate GPA had large positive effects on fellowship support. Graduate GPA and previous graduate work had substantial negative net relationships with the dependent variable. Among men,

BEST COPY AVAILABLE

undergraduate fellowships had a strong positive effect on graduate fellowship support. Undergraduate GPA also had a positive although smaller effect.

For both women and men, the receipt of undergraduate fellowships was strongly related to graduate fellowship support. This suggests that both undergraduate and graduate fellowships were awarded for similar reasons, presumably merit. Among women, several additional variables appear to have affected graduate fellowship support. Once more, the human capital accumulation of men and women appears to have emphasized different aspects of departmental rewards and opportunities. Similar resources and characteristics among female and male graduate students resulted in different attainment structures. Unless clear differences in gender competitiveness, personality, motivation, or other individual characteristics pertinent for the awarding of TA's, RA's and fellowships existed between and within disciplines, these discrepancies raise serious questions.

From equations 4 and 5, one may observe that the processes through which students became associated with mentors of varying scholarly prestige also demonstrated intriguing differences between the sexes. Among men, graduate GPA, previous graduate training and studying in the natural sciences were positively related to the number of extramural grants received by mentors. For women, studying in the natural sciences and to a lesser degree being married, pace of graduate progress and age were positively related to mentor grant receipt. However, women with previous graduate training tended to work with mentors having relatively few grants.

BEST COPY AVAILABLE

More gender differences were found when mentor citations were considered. Among women, studying in the natural sciences had a substantively large positive direct relationship with mentor citations while studying in the arts had a strong negative net relationship. Among male students, graduate GPA, previous graduate work and studying in the natural sciences were positively related to mentor citations. Studying in the arts had a negative relationship with mentor citations.

In terms of mentor grant receipt, men received substantially more return from graduate GPA and prior graduate training than did women. The latter of these 2 relationships was reversed in sign so that previous forms of human capital investment that aided men penalized women. Furthermore, increases in graduate GPA appear to have helped male students to associate with well cited mentors but female students received no such return. Men also gained a positive return in mentor citation for previous graduate training while women did not. These relationships suggest that men tended to experience advantages in gaining access to relatively distinguished mentors that are difficult to explain by merit or chance alone. One might argue that the previous graduate training of men was somehow superior to that of women. However, this possibility is highly tenuous given that women tended to perform equally or better than men as undergraduates.

With equation 5a we considered net relationships involving student publications. Among men, studying in the

BEST COPY AVAILABLE

natural sciences represented the substantively strongest positive net effect on scholarly production. RA support and mentor grant receipt exerted substantively smaller positive effects. The scholarly production of women was negatively affected by being married, graduate GPA and the pace of graduate study. Undergraduate GPA, RA support and less substantively, TA support, were positively related to women's scholarly production.

Several of these findings are striking. For example, while there was no net difference in publication between married and unmarried men, being married directly reduced female publication by an average of four-tenths of an article. Also, women gained more in scholarly production than men as a direct result of obtaining an RA. Women also returned more production from TA support than did men although the substantive impact was not large. Interesting, mentor scholarly prestige did not appear to seriously influenced the scholarly production of graduate students net of other factors.

Gender differences in publication partially reflected the existence of inconsistent and sometimes countervailing characteristics of the reward system. Women were especially dependent on RA's for publication but they tended not to obtain these awards as readily as men except in the social sciences. Furthermore, women received more fellowships than men but this tendency seems to have lowered the likelihood of obtaining RA's. Women received significantly fewer RA's in the natural sciences and the arts than men and they also

BEST COPY AVAILABLE

published much less than men. Nevertheless, women in the social sciences received somewhat more RA support than men yet published slightly less.

With present affirmative action policies, women may be encouraged to enter graduate school through the awarding of fellowships. However, fellowships may not enhance students integration into ongoing departmental activities and likely do not contribute to long term scholarly performance. Fellowship awards may actually reduce involvement in productive work because they limit financial need and therefore students may be less apt to seek research or teaching positions. Hence, it appears to be important for women to be integrated into the entire (e.g., not just fellowship awards) departmental reward system in order to increase their opportunities to publish prior to graduation.

SUMMARY AND CONCLUSIONS

Based on merit, do women graduate students have equal access to prestigious faculty sponsorship and departmental rewards and opportunities? The women analyzed in this study appear to have entered graduate school with qualifications roughly equal to those of their male counterparts. Despite this, they tended to accumulate less human capital than men during graduate school. Several of our findings suggest that, on average, women may not have had equal access to career relevant opportunities and resources. For example, it is unclear why previous graduate study and graduate GPA are positively related to working with prestigious professors for male but not female graduate students. Furthermore, our data

BEST COPY AVAILABLE

give the general impression that women received more equal treatment in the social sciences than in others areas.

The accumulation of human capital in graduate school can improve women's chances for achieving equal professional status with men. If however, women do not obtain the human capital stock necessary to meet presumably meritocratic labor market evaluation criteria, sex inequality can persist indefinitely even in the absence of discriminatory hiring and promotion. In The Fair Science, Cole (1979:256) asserts that the "triple penalty" for American women scientists has been significantly reduced, and "the signs and symbols of sex discrimination in the academic community have diminished to a significant degree". These conclusions may be overly optimistic however. For example, the work of Graham (1970), the National Academy of Sciences (1979), and Reskin (1977) suggests that gender based inequality in academia is unlikely to change significantly over the next several years. There might have been a reduction in pressure on women not to pursue an academic career and affirmative action inspired legislation may have reduced market discrimination but, what these changes will mean for women in academia is unknown. For example, most (if not all) of the relationships examined in this paper are largely immune to current affirmative action policies in the absence of faculty cooperation.

Given present evaluation criteria for academic merit, differential training of female and male graduate students will likely lead to unfavorable career consequences for women. Therefore, women graduate students should be constantly

BEST COPY AVAILABLE

reminded of the importance of research in the academic community, be encouraged to get involved in research projects and be more assertive in applying for research assistantships. At the same time, granting agencies could perhaps encourage faculty members with grant monies to actively recruit women as research assistants. Nevertheless, the potential for sex discrimination in graduate school will remain so long as widely held social values legitimate sexist attitudes and behavior.

BEST COPY AVAILABLE

NOTES

1. It would be interesting to analyze the possible reciprocal causal influences between mentor scholarly prestige and departmental awards. Unfortunately, there is no legitimate way to estimate these relationships given the data and theory. Such a model violates the order condition for identification and therefore cannot be properly estimated (Duncan, 1975: 81-90). As a result, we are restricted to estimating a reduced form of the two sets of equations.

2. Clearly, we are assuming that students' final graduate GPA is a good indication of their early course grades. We see no problem with this, especially when one considers that courses taken for a grade are often completed in the first half of graduate study. Furthermore, length of study, by necessity, has a limiting influence on factors such as the number of TA's students receive. Student's studying for 3 years are likely to receive fewer TA's than students studying 6 years. Therefore, length of study should be controlled to prevent bias due to some students accumulating awards as much for longevity as for merit. Since we are not concerned with the causes of length of study or GPA and because we have no a priori reason to believe they are affected by the endogenous variables, it is proper to treat these characteristics as exogenous. Some readers might feel more comfortable thinking of our structural form mentor characteristics and departmental rewards equations as being reported in reduced form.

BEST COPY AVAILABLE

3. Missing data required 6 cases to be excluded from the analysis. The possibility of temporal variation in the theoretical relationships was initially controlled for with dummy variables. These variables were eventually dropped because no meaningful differences across time were uncovered.

4. The funding attached to grants was also collected but was so highly correlated with number of grants that only the latter was controlled in the analysis reported here. Mentors averaged 1.4, 5.9, and 1.0 grants and 35, 111, and 11 citations in the social sciences, natural sciences, and arts respectively.

5. One reviewer expressed concern over the proportion of students who did not publish. These figures were 52% (social sciences), 29% (natural sciences), and 64% (arts). We suspect the reviewer was concerned about the possibility of heteroskedastic disturbances across different numbers of publications. However, scatterplots of the residuals and publications gave no indication of this problem for either gender. Therefore, we have reported OLS solutions.

6. It is important to note that the issue of inference should not dominate these analyses. The data are limited to a specific population and how generalizable the findings are is unclear. Standard errors are reported to indicate the extent of variation around the average effects. Currently, we are expanding the study to include additional U. C. campuses. Eventually, these data will also allow us to consider student race. This was not possible at Santa Barbara as very few non-white U.S. citizens earned a Ph.D. between 1972 and 1978.

BEST COPY AVAILABLE

7. A reviewer suggested the need for examining possible interactions involving area of study. It was noted that such interactions were possible because graduate students' working relationship with their faculty sponsor may be especially essential in the natural sciences. We considered several interactions in various combinations but their substantive impacts were small (and their standard errors were often larger than the coefficients). Therefore, we have chosen to not dwell upon this aspect of the analysis.

BEST COPY AVAILABLE

FIGURE 1

Model of Human Capital Accumulation During Graduate School

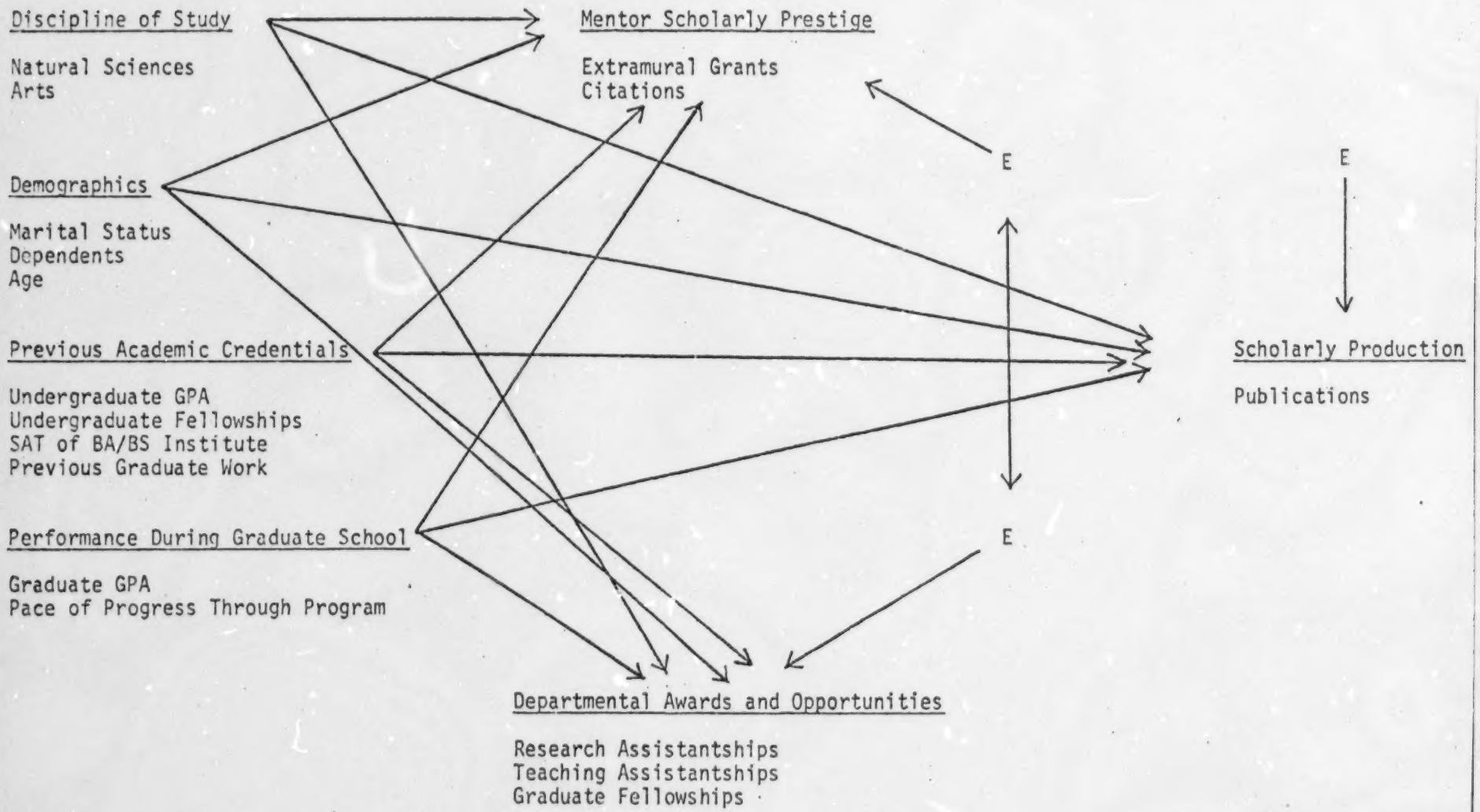

TABLE 1

Means and Standard Deviations of Observed Variables

Variable	Women (N = 112) Mean	Women (N = 112) Standard Deviation	Men (N = 599) Mean	Men (N = 599) Standard Deviation
Natural Sciences	.24	.42	.41	.49
Arts	.23	.42	.09	.29
Marital Status	.26	.44	.36	.48
Dependents	.15	.64	.48	1.02
Age	27.28	6.12	25.08	3.88
Undergraduate GPA	3.29	.35	3.18	.41
Undergraduate Fellowships	.05	.56	.01	.18
SAT of BA/BS Institute	1066.53	145.76	1067.75	140.81
Previous Graduate Work	.59	.49	.57	.49
Graduate GPA	3.69	.27	3.64	.35
Pace of Progress Through Program	5.83	1.81	5.85	1.81
Research Assistantships	.46	.85	.72	1.30
Teaching Assistantships	1.57	1.34	1.69	1.49
Graduate Fellowships	.41	1.08	.18	.73
Extramural Grants	2.22	3.72	3.27	4.63
Citations	47.79	58.49	64.08	85.16
Publications	.82	1.08	1.34	1.72

TABLE 2

Gender Comparisons for Outcome Variables

Controlling Discipline of Study

Mean
(SD)

	Social Sciences		Arts		Natural Sciences	
	Male	Female	Male	Female	Male	Female
RA	.33 (.69)	.57 (.89)	.16 (.47)	.00 (.00)	1.33 (1.69)	.70 (1.02)
TA	1.41 (1.17)	1.37 (1.20)	2.01 (1.31)	1.87 (1.39)	1.95 (1.78)	1.75 (1.55)
Graduate Fellowships	.22 (.79)	.36 (.94)	.07 (.26)	.08 (.39)	.18 (.74)	.89 (1.60)
Citations	33.78 (42.06)	40.70 (41.24)	11.69 (27.36)	8.32 (10.99)	111.53 (105.90)	101.31 (77.78)
Extramural Grants	1.37 (2.20)	1.36 (1.84)	1.05 (2.02)	.87 (1.66)	6.01 (5.66)	5.43 (5.89)
Publications	.92 (1.40)	.85 (.97)	.79 (1.39)	.26 (.49)	1.98 (1.93)	1.31 (1.46)
N	291	59	58	26	250	27

71

TABLE 3a

Structural, reduced and selected semi-reduced form equation estimates.

Female Sample

Metric
(Standard Error)
[Beta]

Equation	1	2	3	4	5	6a	6b	6c	6d
Variable	RA	TA	Graduate Fellowship	Extramural Grants	Citations	Publications	Publications	Publications	Publications
Constant	.57	.73	.95	6.29	108.27	2.04	1.90	2.18	2.24
Natural Science***	.06 (.20) [.03]	.47 (.30) [.15]	.52** (.24) [.20]	4.97** (.71) [.57]	69.02** (12.31) [.50]	.48 (.31) [.19]	.36 (.24) [.14]	.43 (.33) [.17]	.45* (.25) [.18]
Arts***	- .56** (.20) [- .28]	.34 (.31) [.11]	- .27 (.24) [- .10]	-1.01 (.72) [- .11]	-28.13** (12.48) [- .20]	- .32 (.25) [- .12]	- .31 (.25) [- .12]	- .45* (.26) [- .18]	- .49** (.25) [- .19]
Marital Status***	- .01 (.18) [- .00]	.62** (.29) [.20]	- .23 (.22) [- .11]	1.12* (.67) [.13]	9.57 (11.58) [.07]	- .40* (.23) [- .16]	- .44** (.22) [- .18]	- .34 (.24) [- .14]	- .34 (.23) [- .14]
Dependents	.22* (.12) [.17]	.10 (.19) [.05]	.00 (.15) [.00]	.55 (.46) [.09]	- 2.65 (7.91) [- .03]	.19 (.15) [.11]	.18 (.15) [.11]	.30* (.16) [.18]	.29* (.16) [.17]
Age	- .03** (.01) [- .25]	- .04* (.02) [- .17]	- .02** (.01) [- .14]	.18** (.05) [.13]	.50 (.91) [.05]	- .01 (.02 [- .09]	- .02** (.01) [- .12]	- .03** (.01) [- .23]	- .04** (.01) [- .24]
Undergraduate GPA	- .00 (.22) [- .00]	.14 (.34) [.03]	.48* (.27) [.15]	-1.09 (.80) [- .10]	5.75 (13.72) [.03]	.47* (.27) [.15]	.50* (.26) [.16]	.50* (.28) [.16]	.52* (.27) [.17]
Undergraduate Fellowship	- .12 (.14) [- .08]	- .14 (.21) [- .05]	.52** (.17) [.27]	- .69 (.59) [- .10]	-9.51 (8.65) [- .09]	- .15 (.17) [- .08]	- .13 (.17) [- .07]	- .21 (.17) [- .11]	- .21 (.17) [- .11]
SAT of BA/BS Institute	- .00 (.00) [- .00]	- .00 (.00) [- .21]	.00 (.00) [.13]	- .00** (.00) [- .23]	- .01 (.03) [- .03]	.00 (.00) [.05]	.00 (.00) [.07]	.00 (.00) [.02]	.00 (.00) [.03]
Previous Graduate Work***	- .19 (.16) [- .08]	- .17 (.25) [- .06]	- .37* (.20) [- .17]	- .98* (.58) [- .13]	-9.67 (10.11) [- .08]	- .03 (.20) [- .01]	- .01 (.19) [- .00]	- .09 (.21) [- .04]	- .09 (.20) [- .04]
Graduate GPA	.34 (.29) [.11]	.64 (.44) [.13]	- .64* (.35) [- .16]	- .43 (1.04) [- .03]	-20.93 (17.91) [- .10]	- .60* (.35) [- .15]	- .60* (.35) [- .15]	- .33 (.36) [- .08]	- .35 (.36) [- .17]
Pace of Progress Through Program	- .03 (.05) [- .06]	.16** (.08) [.22]	.01 (.06) [.02]	.31* (.18) [.15]	-1.44 (3.19) [- .04]	- .13** (.06) [- .23]	- .14** (.06) [- .25]	- .13** (.06) [- .21]	- .13** (.06) [- .22]
RA						.42** (.12) [.33]	.41** (.11) [.32]		
TA						.15** (.07) [.19]	.15** (.07) [.19]		
Graduate Fellowship						- .00 (.10) [- .01]	- .01 (.09) [- .01]		
Extramural Grants						- .03 (.03) [- .10]		- .01 (.03) [- .04]	
Citations						.00 (.00) [.01]		.00 (.00) [.06]	
R^2	.19	.23	.26	.46	.35	.33	.33	.22	.22

* $.10 \geq p > .05$
** $p \leq .05$
***Denotes binary variables. Although standardized regression coefficients are reported for these variables, they cannot be interpreted as usual beta weights (see Cohen & Cohen 1965: 184).

TABLE 3b

Structural, reduced and selected semi-reduced form equation estimates

Male Sample

Metric
(Standard Error)
[Beta]

Equation	1	2	3	4	5	6a	6b	6c	6d
Variable	RA	TA	Graduate Fellowship	Extramural Grants	Citations	Publications	Publications	Publications	Publications
Constant	2.33	2.00	.23	- .08	84.81	-.26	-.30	-.06	-.03
Natural Science***	.90**	.40**	- .02	4.53**	68.03**	.64**	.91**	.70**	1.02**
	(.11)	(.13)	(.06)	(.37)	(7.00)	(.18)	(.16)	(.17)	(.15)
	[.34]	[.13]	[- .01]	[.48]	[.39]	[.18]	[.26]	[.20]	[.29]
Arts***	- .15	.54**	- .15	- .37	-21.32**	- .06	- .07	- .08	- .12
	(.17)	(.21)	(.10)	(.58)	(10.78)	(.23)	(.24)	(.23)	(.23)
	[- .03]	[.10]	[- .06]	[- .02]	[- .07]	[- .01]	[- .01]	[- .01]	[- .02]
Marital Status***	- .20	- .16	- .10	- .54	2.23	- .03	- .06	- .05	- .08
	(.13)	(.15)	(.07)	(.43)	(8.07)	(.17)	(.17)	(.17)	(.17)
	[- .07]	[- .05]	[- .06]	[- .05]	[.01]	[- .01]	[- .01]	[- .01]	[- .02]
Dependents	.06	.04	.07*	- .15	-4.45	- .07	- .08	- .06	- .08
	(.06)	(.07)	(.03)	(.22)	(4.09)	(.09)	(.09)	(.08)	(.09)
	[.04]	[.02]	[.09]	[- .03]	[- .05]	[- .04]	[- .05]	[- .04]	[- .04]
Age	- .04**	- .06**	- .01**	- .03	-2.62**	.00	.00	- .00	- .00
	(.01)	(.01)	(.00)	(.05)	(.97)	(.02)	(.02)	(.02)	(.02)
	[- .12]	[- .17]	[- .09]	[- .02]	[- .12]	[.00]	[.00]	[- .00]	[- .01]
Undergraduate GPA	- .29**	.01	.15**	- .49	-10.68	.07	.05	.05	.02
	(.12)	(.14)	(.07)	(.40)	(7.61)	(.16)	(.17)	(.16)	(.16)
	[- .09]	[.00]	[.08]	[- .04]	[- .08]	[.01]	[.01]	[.01]	[.00]
Undergraduate Fellowship	- .22	.47	1.14**	- .11	-7.28	- .43	- .42	- .41	- .42
	(.26)	(.31)	(.15)	(.87)	(16.27)	(.37)	(.37)	(.35)	(.36)
	[- .03]	[.06]	[.29]	[- .00]	[- .01]	[- .04]	[- .04]	[- .04]	[- .04]
SAT of BA/BS Institute	.00	- .00	.00	.00	- .00	.00	.00	.00	.00
	(.00)	(.00)	(.00)	(.00	(.02)	(.00)	(.00)	(.00)	(.00)
	[.02]	[- .02]	[.01]	[.00]	[- .00]	[.04]	[.04]	[.04]	[.04]
Previous Graduate Work***	.06	.20*	- .01	.80**	14.31**	.12	.17	.12	.18
	(.10)	(.12)	(.06)	(.36)	(6.43)	(.14)	(.14)	(.14)	(.14)
	[.02]	[.06]	[- .00]	[.09]	[.08]	[.03]	[.05]	[.03]	[.05]
Graduate GPA	- .00	.26	- .05	.82*	15.90*	.12	.18	.11	.17
	(.14)	(.17)	(.08)	(.47)	(8.91)	(.19)	(.19)	(.19)	(.19)
	[- .00]	[.06]	[- .02]	[.06]	[.05]	[.02]	[.03]	[.02]	[.03]
Pace of Progress Through Program	- .02	.04	.01	.08	-1.95	- .03	- .03	- .04	- .03
	(.03)	(.03)	(.01)	(.10)	(1.87)	(.04)	(.04)	(.04)	(.04)
	[- .03]	[.05]	[.03]	[.03]	[- .04]	[- .04]	[- .03]	[- .04]	[- .03]
RA						.09*	.13**		
						(.05)	(.05)		
						[.07]	[.10]		
TA						- .01	- .02		
						(.04)	(.04)		
						[- .01]	[- .02]		
Graduate Fellowship						.04	.03		
						(.09)	(.09)		
						[.01]	[.01]		
Extramural Grants						.06**		.06**	
						(.01)		(.01)	
						[.16]		[.17]	
Citations						.00		.00	
						(.00)		(.00)	
						[.01]		[.01]	
R^2	.17	.07	.11	.27	.25	.14	.12	.13	.11

* $.10 \geq p > .05$

** $p \leq .05$

*** Denotes binary variables. Alghough standardized regression coefficients are reported for these variables, they cannot be interpreted as usual beta weights (see Cohen & Cohen 1965: 184).

APPENDIX A

Disturbance correlations between equations. Coefficients above the diagonal are from the female model. Coefficients below the diagonal are from the male model.

Equation	RA	TA	Graduate Fellowships	Extramural Grants	Citations
RA	----	-.03	-.08	.17	.13
TA	.11	----	-.07	-.03	.05
Graduate Fellowships	.04	-.02	----	.09	.22
Extramural Grants	.17	-.06	.00	----	.08
Citations	.07	.04	-.03	.31	----

APPENDIX B

Zero-order correlations. Coefficients above the diagonal are from the female sample. Coefficients below the diagonal are from the male sample.

Variables	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	Y1	Y2	Y3	Y4	Y5	Y6
X1: Arts	----	-.31	.13	-.14	.06	-.09	-.05	-.01	-.02	.33	-.03	-.30	.12	-.17	-.20	-.37	-.29
X2: Natural Sciences	-.28	----	-.00	.04	-.14	.12	.17	-.15	.16	-.20	.11	.15	.07	.24	.49	.52	.26
X3: Dependants	-.04	.03	----	-.05	.35	-.06	-.02	-.04	.05	-.07	.05	.05	-.01	-.09	.18	-.05	.08
X4: Marital Status	-.11	.17	.58	----	.02	.11	.16	.12	-.12	-.27	.13	.05	.13	-.03	.09	.12	-.06
X5: Age	.04	-.26	.44	.15	----	-.09	-.09	.07	.08	-.33	-.11	-.20	-.24	-.21	.21	-.01	-.12
X6: SAT of BA/BS Institute	-.06	.01	-.03	-.02	-.03	----	.16	.00	.11	-.02	-.07	-.00	-.24	.20	-.21	.03	.05
X7: Undergraduate Fellowships	-.02	-.02	-.02	-.03	-.04	.03	----	-.03	.08	-.02	-.03	-.05	-.04	.31	-.06	-.00	-.07
X8: Undergraduate GPA	.07	-.11	-.06	-.04	-.05	-.07	.03	----	-.04	.05	.09	-.01	.05	.09	-.14	-.03	.09
X9: Previous Graduate Study	-.06	.03	.05	.00	.22	-.05	-.00	-.08	----	-.15	-.12	-.09	-.16	-.09	-.07	.01	.03
X10: Pace of Graduate Study	.12	-.13	-.20	-.23	-.25	.13	.03	-.11	-.19	----	-.13	-.09	.22	.07	-.11	-.22	-.19
X11: Graduate GPA	-.02	.17	.01	.10	-.00	.03	-.04	.09	-.00	-.19	----	.18	.20	-.12	.03	-.01	.00
Y1: RA	-.14	.39	-.03	.00	-.19	.03	-.03	-.13	.02	-.03	.05	----	.03	-.01	.18	.22	.41
Y2: TA	.07	.15	-.09	-.06	-.20	-.01	.06	.00	.02	.07	.07	.17	----	-.07	.04	.04	.12
Y3: Graduate Fellowships	-.05	-.01	-.00	-.04	-.09	.02	.30	.09	-.03	.05	-.04	.03	.01	----	.09	.29	.06
Y4: Extramural Grants	-.16	.50	-.06	.00	-.16	.02	-.01	-.10	.09	-.03	.13	.34	.04	-.00	----	.36	.07
Y5: Citations	-.20	.47	-.07	.06	-.22	.01	-.02	-.09	.08	-.09	.14	.26	.12	-.03	.48	----	.23
Y6: Publications	-.11	.31	-.05	.01	-.09	.04	-.05	-.03	.06	-.07	.09	.21	.03	.00	.30	.21	----

REFERENCES

Alexis, M.

1974 "The Political Economy of Labor Market Discrimination: Synthesis and Exploration." in Horowitz, A. and Von Furstenberg, G. (eds.), Patterns of Discrimination. D.C. Heath: Lexington, Mass.

Astin, Alexander W.

1971 Predicting Academic Performance in College. Free Press: N. Y.

Astin, Helen S.

1969 The Woman Doctorate in America. Russell Sage Foundation: New York, N.Y.

Astin, Helen S. and Alan E. Bayer

1973 "Sex Discrimination in Academia", in Academic Women on the Move. Alice Rossi and Ann Calderwood (eds.) 353-356. Russell Sage Foundation: New York, N.Y.

Bayer, Alan E. and H.S. Astin

1968 "Sex Differences in Academic Rank and Salary Among Science Doctorates in Teaching." Journal of Human Resources 2: 191-201.

1975 "Sex Differentials in the Academic Reward System." Science 188: 796-802.

Bernard, J.

1964 Academic Women. The Pennsylvania State University Press: University Park, PA.

Centra, John A.

1974 Women, Men and the Doctorate. Educational Testing Service: Princeton, N.J.

BEST COPY AVAILABLE

Cole, Jonathan R.

1979 Fair Science. Free Press: New York, N.Y.

Crandall, V.

1975 "Sex Differences in Expectancy of Intellectual and Academic Reinforcement" in R. Kesler-Unger and F. Denmark (eds.) Women: Dependent or Independent Variable. N. Y.: Psychological Dimensions.

Creager, J. A.

1971 The American Graduate Student: A Normative Description. American Council on Education Research Report: Washington, D.C.

Duncan, Otis Dudley.

1975 Introduction to Structural Equation Models. N. Y.: Academic Press.

Eiden, L.J.

1976 "Trends in Female Degree Recipients." American Education (12) back cover.

Epstein, C. Fuchs

1973 "Bringing Women In: Rewards, Punishments and the Structure of Achievements." Annual of the New York Academy of Sciences CCVIII.

Feldman, Saul D.

1973 Escape From the Doll's House; Women in Graduate and Professional School Education. N. Y.: McGraw-Hill.

Folger, John K., Helen S. Astin and Alan E. Bayer

1970 Human Resources and Higher Education. Russell Sage Foundation: New York, N.Y.

BEST COPY AVAILABLE

Fulton, O.

1975 "Rewards and Fairness: Academic Women in the United States" in M. Trow (ed.) Teachers and Students. San Francisco: McGraw Hill Book Co.

Fox, Mary F.

1981 "Sex, salary, and achievement: Reward dualism in academia. Sociology of Education 54:71-84.

Graham, Patricia Albierg

1970 "Women in Academe" Science, CLXIX 25 (September): 1284-90.

Harris, Ann Sutherland

1974 "The Second Sex in Academe" in J. Stacey, S. Bereaud, and Joan Daniels (eds.) And Jill Came Tumbling After. N. Y.: Dell.

HEW

1978 Condition of Education. U.S. Government Printing Office.

Hirschberg, N. and S. Itkin

1978 "Graduate Student Success in Psychology." American Psychologist 12: 1083-93.

Holmstrom, E.I. and R. W. Holmstrom

1974 "The Plight of the Woman Doctoral Student." American Educational Research Journal 1: 1-17.

ISI

1970-80 Institute for Scientific Information. Social Sciences Citation Index and Science Citation Index. Philadelphia, P

BEST COPY AVAILABLE

Krueger, Ann O.

1963 "The Economics of Discrimination". Journal of Political Economy 71: 481-486.

Long, John Scott

1978 "Productivity and Academic Position in the Scientific Career." American Sociological Review 43: 889-908.

Long, J. S., P. Allison, and R. McGinnis

1979 "Entrance into the academic career." American Sociological Review 44:816-30.

Long, J. S. and R. McGinnis

1981 "Organizational context and scientific productivity." American Sociological Review 46:422-42.

Marwell, Gerald, R. Rosenfeld, and S. Spilerman

1979 "Geographic Constraints on Womens Careers in Academia" Science 21: 1225-31.

McGinnis, R., P. Allison, and J. S. Long

1982 "Postdoctoral training in bioscience: Allocation and outcomes." Social Forces 60:701-722.

Mincer, J. and S. Polacheck

1974 "Family Investments in Human Capital: Earnings of Women" Journal of Political Economy Supplement. March.

National Academy of Sciences/National Research Council

1979 Climbing the Academic Ladder: Doctoral Women Scientists in Academe. Washington, D.C.: National Academy of Sciences.

BEST COPY AVAILABLE

Nielsen, Linda L.

1979 "Sexism and Self-healing in the University." Harvard Educational Review 49:467-76.

Phelps, Edmund S.

1972 "The Statistical Theory of Racism and Sexism." American Economic Review 62:659-69.

Reskin, Barbara

1980 "Fair Science: A Fair Test?" Contemporary Sociology 9: 793-95.

1977 "Scientific productivity and the reward structures of science" American Sociological Review 42: 491-504.

Roby, Pamela

1973 "Institutional Barriers to Women Students in Higher Education." in A. Rossi and A. Calderwood (eds.) Women on the Move. Russel Sage Foundation: New York, NY.

Thurow, Lester

1979 Poverty and Discrimination. The Brookings Institute: Washington D.C.

Weisbrod, Burton A.

1975 "Education and investment in human capital". In D. Levine and M. J. Bane (eds) The "Inequality" Controversy: Schooling and Distributive Justice (pp. 123-146), Basic Books: N. Y.

Wykstra, Ronald A.

1971 Education and the Economics of Human Capital. Free Press: N. Y.

BEST COPY AVAILABLE

Zuckerman, Harriet and J.R. Cole

1975 "Women in American Science." Minerva 13: 82-102.

BEST COPY AVAILABLE